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CURRICULUM GUIDE

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A C K N O W L E D G M E N T S

The Department of Education acknowledges with appreciation the contribution of the following Ad Hoc Committee members to the preparation of this Guide.

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School Drafting. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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TABLE OF CONTENTS

		Page
I.	INDUSTRIAL EDUCATION	1
II.	OBJECTIVES	1
	A. Industrial Education Objectives	1
	B. Mechanics Career Field Objectives	2
	C. Major Area of Study Objectives	2
III.	EVALUATION	2
IV.	ORGANIZATION	3
	A. Guide Organization	3
	B. Program Organization	4
	1. Program Description	4
	2. Organization of Majors	4
	3. Facility Organization	5
V.	CAREER OPPORTUNITIES	7
VI.	AUTOMOTIVES COURSE MODULES	8
	1. Mechanics 12	8
	2. Automotives 22A (Power Systems)	26
	3. Automotives 22B (Power Train)	35
	4. Automotives 22C (Alignment Brakes)	58

Page

5. Automotives 32A (Fuel and Tune-Up) 71

6. Automotives 32B (Electrical System) 81

7. Automotives 32C 90

I. INDUSTRIAL EDUCATION

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in Industrial Arts and Vocational Education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's knowledge of himself, his talents and his skills.

The Industrial Education course "guides" provide the teacher with an outline of the topics, generalizations and concepts selected as most relevant for the physical and mental development of the students and the logical development of the subject area in accordance with the resources of the school in both teaching personnel and facilities.

The Guide leaves much scope for the teacher to develop content related to the topics, especially in writing behavioral objectives describing specific changes in student behavior anticipated from the learning tasks.

It is expected that each school district will develop a program of Industrial Education appropriate to the fulfilment of the needs of its student clientele.

II. OBJECTIVES

A. Industrial Education Objectives

The general objectives of Industrial Education complement the aims and objectives of the secondary school. The objectives of Industrial Education are to:

1. To provide students with the curriculum content designed to develop fundamental tool and procedural skills which help prepare them to enter a family of occupations.

2. To provide students with courses that serve as vehicles which help them relate their academic knowledge to vocational competencies.

3. To provide students the opportunity to develop basic competencies, both academically and in work skills to enter either a job or a post-high school institution for further education.

4. To provide students with the environment whereby they may develop sound attitudes, acceptable work habits, and achieve a feeling of accomplishment.

B. Mechanics Career Field Objectives

The Mechanics courses should give students an opportunity to:

1. Obtain exposure to, and a basic understanding of, the career field.

2. Develop the basic skills and knowledge to gain job entry or articulation with post-high school institutions.

3. Develop a standard of craftsmanship acceptable to the trade and himself.

C. Major Area of Study Objectives

The automotive courses should give the students an opportunity:

1. To develop methods of analytical thinking related to automotive problems.

2. To develop technical knowledge, attitudes and skills required in the automotive service.

3. To develop an awareness of the impact of the automobile on society.

III. EVALUATION

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by the students. Allowance should be made for both self and teacher evaluation and in some cases peer evaluation. Evaluation should further be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. Their categories are as follows:

a. Verbal and Written Communication
b. Personal Growth
c. Manipulative Skills

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation see the Industrial Education Handbook.

IV. ORGANIZATION

A. Guide Organization

The course guides are developed on the following pattern:

1. Topic: Each course is subdivided into a number of topics.

2. Generalization: The main generalization or "big" idea that students should learn follows each topic.

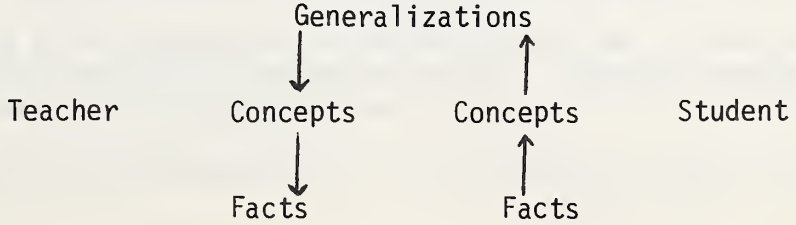
3. Concepts: The concepts divide the topic into the teaching components. They give more direction on specific areas that should be studied.

4. Behavioural Objectives: These describe specific changes in student behaviour which result from the learning tasks he performs.

   The guide gives only a few sample behavioural objectives. It is the responsibility of the teacher to develop as many behavioural objectives as he can teach in the time available.

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy whereas in learning, the student begins with facts and moves upward.



5. Suggested Activities: A few suggestions are made as to the types of activities that could be used to achieve the behavioural objectives.

6. Resource Materials: This column suggests where materials may be obtained.

B. Program Organization

1. Program Description

The Automotive modules give students the opportunity to learn the theory and skills necessary in the automotive industry. They will learn to identify and use hand and power tools to perform the major procedures in diagnosing, repairing and rebuilding equipment. Their jobs can include activities such as disassembling and assembling shop equipment to repairing or/rebuilding a vehicle. In the process they will learn about the trade, job opportunities, business practices and enough skills to get a job, go into apprenticeship or enhance their avocational interests.

2. Organization of Majors

The major is divided into six-five credit modules and one module of five-ten credits. Entry into the major is through, Mechanics 12 or General Technology 10. The second and third level modules ("22" and "32") are non-sequential and can be taken in any order with the exception of Automotives 32C.

32C is the last course in the 35 credit sequence and can be used to:

a. Provide greater depth to a module taken previously.

b. Take work in actual mechanics under a work experience plan whereby the Automotives teacher supervises the student on the job. The student must be under the supervision of a journeyman while on the job.

In addition to the modules set out in the major for Automotives a student may select modules designated as minors. These are normally the first level or introductory course of the area, e.g. Electricity would be Electricity-Electronics 12.

A student wishing to meet the requirements of the Apprenticeship Branch must complete all seven modules in the major area.

Some students, however, may take only a few modules in a major area as a supplement to their academic program or they may broaden their selection to other career fields. The scope of the Industrial Education program allows the flexibility necessary for the program to be tailored to meet the interests and needs of the individual class or student.

The chart on Page 6 gives a graphic description of the Automotives program. Each module is identified and the sequences are indicated by lines, e.g. After a student has completed one of Mechanics 12 or General Technology 10 he/she may advance to any module to which the solid line leads.

Once a student has enrolled in a "22" or second level course he may also select modules from the minor fields.

Students may find some of the courses in the listed related field beneficial to their career program development.

3. Facility Organization

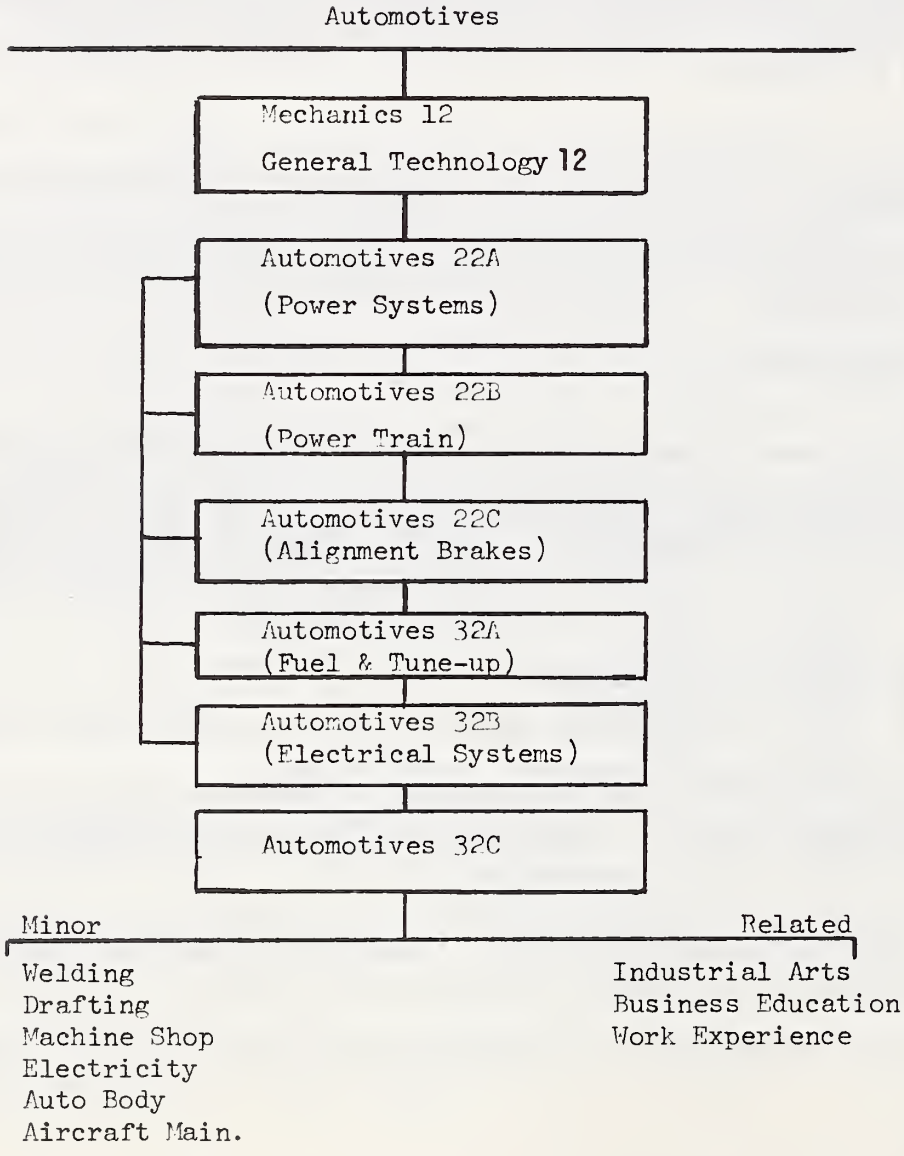
The organization of the physical facilities is in part determined by the original plan. There are however adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab or shop is organized. While most of the shops in Alberta are designed for 16 to 20 students a number of factors must be considered in the final assignment of class load. These factors include:

1. physical size of the shop or laboratory
2. type of student
3. amount of equipment
4. type of programming
5. type of course
6. training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class loads are determined.

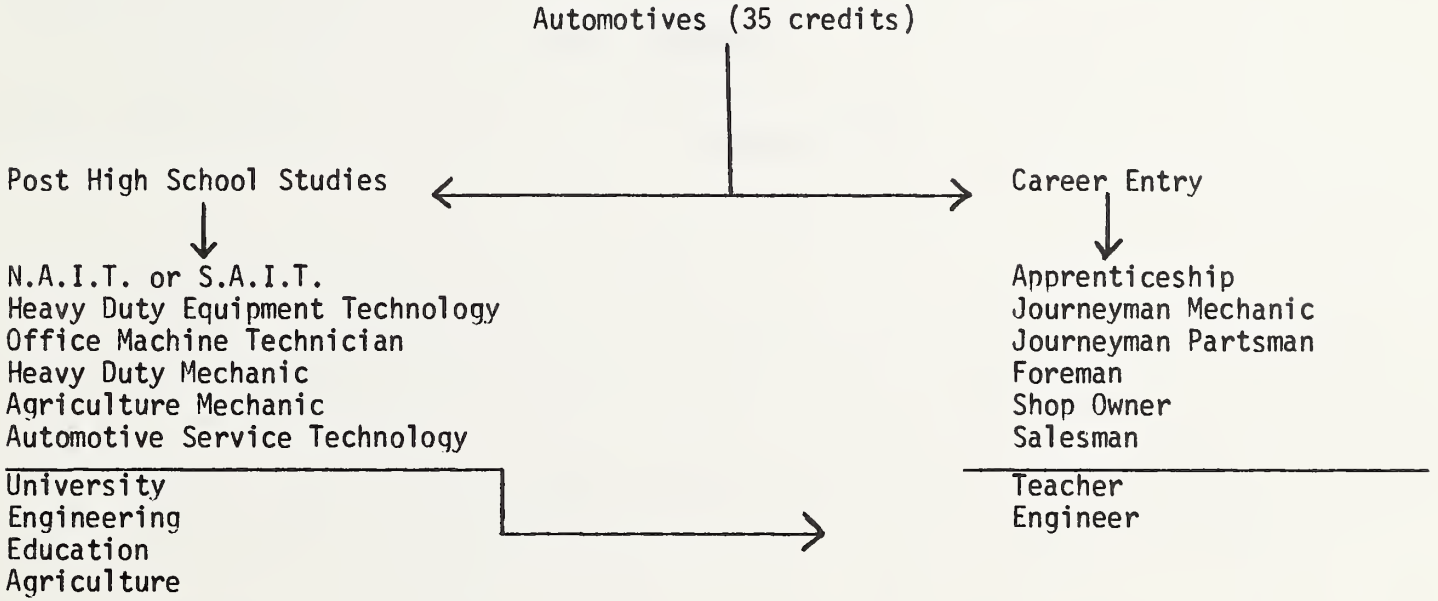
C A R E E R F I E L D

MECHANICS



V. CAREER OPPORTUNITIES

Students having taken all or most of the modules in the Automotives major may look forward to the following career areas:



VI. MECHANICS

1. Mechanics 12

INTRODUCTION

Power Mechanics is the study of the sources and transmission of power. Through the reading and activities the student will engage in as he progresses through these units of study, he will gain a concept of work, energy and power. The course itself is not intended to provide trades training but rather to introduce the student to the broad scope of energy sources, its transmission and its application.

Testing and analysis, reading and research, practice and demonstration makes up the core of the program.

I. OBJECTIVES

The specific objectives of Mechanics 12 are:

1. To help the student understand the many basic laws and principles of science at work in Mechanics, and relate these laws and principles to the vast area of power technology.

2. To allow the student to gain an insight into the construction and requirements of machines which convert energy to useful work.

3. To enable the student to understand the use, care and control of the power machine.

4. To provide the student with realistic experiences so that he is better able to make a career choice based on accurate information.

II. CONTENT SUMMARY

1. Career field study
2. Safety
3. Shop practices
4. Automobile Care and Ownership
5. Power Sources
6. Power Plant Systems
7. Transmission of Power
8. Fluiding (optional)

III. REFERENCES

Section I

Stephenson, George E. *Power Mechanics*. Delmar Publishings, Inc.

* Nash. *Automotives Fundamentals*. 3rd ed. P. 169.

* Duffy. *Power - Prime Mover of Technology*. 1972 General Publication

Purvis, Jud and William K. Toboldt. *Motor Services Automotive Encyclopedia*. The Goodheart Wilcox Co. Inc.

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National Fluid Power Association, P.O. Box 49, Thiensville, Wisconsin.

Purvis. *All About Small Gas Engines*. General Publication, 1960.

Venk, E. and W. Billiett. *Automotive Fundamentals*. American Technical Society.

Engine Charts and Plans available from: General Motors Limited, Department of Public Relations, Oshawa, Ontario; Ford Motor Compnay, Education Affairs Department, The American Road, Dearborn, Michigan 48121; Internation Harvester Company Ltd.; Chrysler Corporation Limited, Community Affairs Department, Box 1919, Detroit, Michigan 48231; Catepillar Tractor Company.

Films. Shell Oil Company of Canada Ltd.

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* Most used.

Section II

Atkinson, Henry. *Mechanics of Small Engines.* McGraw-Hill of Canada Ltd.

Beeler, Samuel C. *Understanding Your Car.* (Second Edition) McKnight and McKnight Publishing Co.

Principles of Engine Analysis. Go-Power Systems.

Hydraulic Power. Laboratory Manual for *Vega Hyndraulic Power Training Unit.*

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Stewart, Henry L. and John M. Storer. *Fluid Power (Text)*and *Fluid Power Transparency Masters.*

Pipe, Ted. *Small Gasoline Engines Training Manual.* (Second Edition)

MacDonald. *Small Gasoline Engines Workbook.*

Small Engines Service Manual. Technical Publications, A.C. Simmonds & Sons Ltd., 285 Yorkland Boulevard, Willowdale, Ontario.

Worthington, Margulis, Crouse. *General Power Mechanics.* (Canadian Edition) McGraw-Hill Publications.

McGuffin, M. J. *Automotive Mechanics.* New ed. 1973. The Macmillan Co. of Canada.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

General Technology - Teachers may may make their own selection of content from this Guide for use in the 65 hour mini-module of the General Technology 10 course.

Career Field: Mechanics

Topic I: CAREER FIELD STUDY

Major: Automotives

Generalization A: There are many occupations within and related to the field of Mechanics.

Course: Mechanics 12

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Career Field Occupations		The student will: a. make a survey of the various occupations available in the career field and list the entry requirements. b. list courses in his school system that lead to his career choice.	Outside speakers. Tours. Guidance Counsellor.	
2. Employment Opportunities - local - regional - national		a. discuss employment opportunities in the Mechanics career field.		
3. Trade Certification		a. explain journeyman certification requirements and articulation with the Apprenticeship Branch.		

Notes:

Topic II: SAFETY

Generalization B: A knowledge and practice of safety is essential in all shop activities.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. Unsafe Act		The student will: a. list the consequences of unsafe acts particularly relating to: - hoists - jacking devices - compressed air - eye injury - hand tools - power equipment - welding equipment - lifting.		
. Unsafe Conditions		a. list unsafe conditions which could lead to injuries.		
. Accident Reporting		a. explain purpose and use of accident report forms.		
. Compensation		a. explain the function of and benefits available under the Workers' Compensation Act.		Workers' Compensation Stud outline by Max Grant, Drumheller.
. First Aid		a. Clean and bandage a cut.		

lotes:

Generalization C: A knowledge of efficient shop practices is based on the care and use of tools and equipment.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Use of tools and equipment (i) Basic		The student will: a. given instruction and demonstration correctly use basic hand tools; -wrenches -hammers -screwdrivers -chisels -punches -etc.		
(ii) Specialized		b. given instruction and demonstration correctly use specialized tools and equipment; -torque wrench -tune-up equipment -pullers -etc.		

Topic IV: AUTOMOBILE CARE AND OWNERSHIP

Generalization D: Efficient maintenance and control of each power device is important to the function of the total unit or system.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Body and Chassis Maintenance		The student will: a. polish a car. b. remove stains such as: - grease or oil - fruit - blood - lipstick - milk		
2. Tool Use		a. use the automotive hand tools correctly.		
3. Lubrication		a. explain how the engine is lubricated. b. lubricate a whole car using the appropriate oils and greases.		
4. Maintenance Inspections		a. make on the spot checks for: - body damage - tire wear - shocks - oil and water leaks - hardware, cushions, glass, steering wheel play.	Discuss car condition. Have students inspect each others cars and write reports on their findings.	

Notes:

Topic X: AUTOMOBILE CARE AND OWNERSHIP (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		b. make a thorough inspection prior to a long trip by checking: - body - electrical system - ignition - horn - lights - generator - battery - tires air pressure wear and condition spare - fuel system pump carburetor air cleaner - cooling system water level anti-freeze fan belt hose conditions - drive system clutch pedal (free travel) transmission oil level differential lubrication level	Perform various inspections and tests.	

Notes:

Topic X: AUTOMOBILE CARE AND OWNERSHIP (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		- power plant oil level oil color - running gear brakes, hand brake shock absorbers, front wheel bearings.		
5. Insurance		a. read an insurance policy and list the coverage on: - property damage - body injury liability - collision and upset - comprehensive - medical payments b. calculate the cost of insurance for adult driver and extra costs for under 25 year old driver.		

Notes:

Generalization E: The origin and control of power is fundamental to modern industrial society.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Power harnessing (historical)		a. given appropriate reading materials and audio-visuals study about the various sources of power as used by man through history; i) muscles ii) simple machines iii) water wheels iv) generators v) windmills vi) steam engines vii) steam generators viii) internal combustion engines ix) rockets.		
2. Heat Engines i) work		a. given background material; i) calculate problems on work performed using the formula ii) define force in newtons work = newton - meters		
ii) power		b. define power as work per unit of time i.e. - newton meter/second c. define horse power d. measure rotary power using a dynamometer.		

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
iii) Types -external -internal		The student will: a. identify and analyze the operation of a steam engine. b. explain the theory of the internal combustion engine.		

Topic VI: POWER PLANT SYSTEMS 20

Generalization F: Power plants consist of a number of interrelated systems.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Fuel system		The student will:		
i) Fuel pump		a. given a fuel pump: i) explain how it operates ii) clean fuel filter	Dismantle and examine several types of fuel pumps.	
ii) Carburetor		b. given a carburetor: i) explain how it works ii) explain the difference between various types: -single barrel -two barrel -four barrel iii) dismantle and assemble units iv) adjust a carburetor v) adjust automatic choke vi) discuss methods of increasing gas mileage.	Study cut-away models. Test fuel pump pressure.	
2. Exhaust System		a. list the dangers of a leak in the exhaust system. b. check the condition of: -exhaust pipe -muffler -tail pipe		
3. Cooling System		a. explain the need for a cooling system. b. list the parts and their functions.	Study charts, slides and models.	

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		c. discuss the uses and types of anti-freeze solutions. d. test anti-freeze for strength. e. examine an air-cooled engine design.		
4. Lubrication System i) oil pump ii) filtering system iii) oil iv) crank case ventilation		a. given an oil pump: i) explain how it operates b. given an oil filler: i) explain its function ii) replace an oil filter on a car c. classify oils used -change oil in an engine d. identify the parts of the ventilating system and service.		

Topic

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. Electrical System i) The Lead-Acid Battery		The student will: a. given a battery: (i.) identify the parts and materials (ii.) test the battery (iii.) prepare it for charging.	Test a battery and then charge it. Film and Slides. Dismantle a Generator.	
ii) The Generator		a. given a generator: (i.) list the parts (ii.) describe its operation (iii.) compare A.C., D.C. and three brush generators (iv.) describe shunt type.		
iii) Generator Controls		a. describe the function of: (i.) cut-out relay (ii.) voltage regulator (iii.) current regulator.		
iv) The Starter		a. given a starting motor to dismantle: - name the parts - describe the principle of operation.		

Notes:

Topic VII: TRANSMISSION OF POWER

Generalization G: The transmission of power can be accomplished through fluid or mechanical means.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Hydraulic Systems		The student will:		
(i.) Systems - steering - brakes - transmission - hydraulic jack - shock absorber - air-oil suspension		a. study Pascal's Law and explain the relationship of pressure, movement and area. b. explain how a hydraulic jack operates. c. explain the operation of a shock absorber. d. discuss the operation of an air-oil suspension system (hydropneumatic).		
(ii.) Components - valves - motors		a. describe the use of remote control valves such as the solenoid valve. b. explain the operation of the following types of hydraulic motors: - vane - gear - radial		
2. Mechanical i) Power Train a) Gears b) Drive shaft c) Clutch d) Differential		a. given model kits, assemble and explain the theory and principles of the function of gears and levers.		

Topic VIII: FLUIDICS (Optional)

Generalization H: The field of Fluidics has added a whole new family of control devices.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Performance Characteristics		The student will: a. make a list of the similarities between hydraulics, pneumatics, electronics and fluidic devices and their performance characteristics.		
2. Symbols		a. given a chart of fluidic symbols, correctly label each symbol.		
3. Coanda Effect		a. given a schematic diagram of bistable element, explain in writing the Coanda principle.		
4. Flip-flop Device		a. given a wall attachment bistable element, connect it to a pressure source and compare its output to a similar device.		
5. Or/nor Device		a. given an or/nor device, correctly connect it to a pressure source and compare its output to a flip-flop device.		
6. And/nand Device		a. given an and/nand device, correctly connect it to a pressure scurce and compare its output to a flip-flop and or/nor device.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
7. Proportional Amplifier		a. given a proportional amplifier connect it to a pressure source and compare its pressure output to its pressure input.		
8. Vortex Amplifier		a. given a vortex amplifier, connect it to a pressure source and thereby use it to restrict and reduce larger primary flows.		
9. Control Systems		a. given several fluidic devices, construct a prescribed circuit and evaluate its performance.		
10. Fluidic Computers		a. given several fluidic devices, construct a prescribed circuit and perform a simple computer operation.		
11. Accessories		a. if time permits, study resistors, capacitors, relays, read-out devices and sensing devices and their operation.		

VI. MECHANICS

2. Automotives 22A

Power Systems

INTRODUCTION

The Automotives 22A module is a 5-credit course, which is pre-requisite for further coures in Automotives.

I. OBJECTIVES

The objectives of Automotives 22A are to:

1. develop in the students the habits of critical thinking in the analysis of engine problems.

2. accustom the students to utilize manufacturers' manuals and a variety of technical publications.

3. familiarize the student with automotive engines, and thus relate his theoretical background to engine repair.

4. provide the student with a basis for further study into power systems at a more advanced level.

5. develop in the student some of the attitudes and skills required of a motor mechanic.

II. CONTENT SUMMARY

1. The internal combustion engine
   -construction and operation

2. The maintenance and repair of the internal combustion engine
   -disassembly procedure
   -engine assembly
   -tune-up

3. Engine cooling and lubrication
   -the heat engine
   -waste control.

III. REFERENCES

The following books may be used as references. Those marked with an asterik (*) are considered most helpful.

* Stockel, M.W. *Auto Mechanics.*

* Stockel, M.W. *Auto Service and Repair.* Goodheart-Wilcox Co.

Toboldt, W. K. and Johnson, L. *Motor Service's Automotive Encyclopedia* Goodheart-Wilcox Co.

Venk, E., and Billiett, W. *Automotive Fundamentals.* American Technical Society.

Crouse, W. *Automotive Mechanics.*

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

The allocation of time to each topic, the order of presentation and the inclusion of enrichment materials should meet the needs of the class.

Topic I: THE INTERNAL COMBUSTION ENGINE

Major: Automotives

Generalization A: All internal combustion engines are basically similar in theory, design and maintenance.

Course: Automotives 22A (Power Systems)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. **The Construction and Operation of Automotive Engines is Based on Scientific Principles.**		The student will: a. relate the concepts of the molecular theory of matter, atmospheric pressure and energy to: (i) value motion (ii) the four-stroke cycle (iii) the factors affecting power output (iv) the efficiency of the engine (v) engine horsepower. b. investigate the relationship and function of the engine components. (i) crankshaft and block assembly (ii) camshaft and related parts (iii) pistons and connecting rod c. investigate and compare a variety of engine designs, their construction and operation. (i) V8 vs. in line (ii) overhead camshaft (iii) air and liquid cooled (iv) rotary and reciprocating.		

Notes:

Topic II: THE MAINTENANCE AND REPAIR OF THE INTERNAL COMBUSTION ENGINE 30

Generalization B: The internal combustion engine requires the adjustment of replacement of parts to maintain peak performance and economy.

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. An Ordered Sequence of Engine Disassembly Procedures and Parts Storage will Facilitate Component Inspection, Cleaning and Measurement (i.) An engine is composed of parts which may not be interchanged. (ii.) Thorough cleaning is required before an accurate inspection and measurement can be obtained. (iii.) An accurate inspection depends on a thorough knowledge of measuring devices.		The student will: a. given an engine to disassemble, follow: (i.) the manufacturer's recommendations (ii.) a logical sequence of sub-assemblies. b. given an engine: (i.) analyse engine deposits (ii.) employ correct cleaning procedures on components. c. given an engine: (i.) use measuring tools with care (ii.) analyse the variety of engine problems encountered.		

otes:

Topic II: THE MAINTENANCE AND REPAIR OF THE INTERNAL COMBUSTION ENGINE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
2. Engine Assembly (i.) Engine assembly procedures are initiated by correct sub-assemblies. (ii.) Lubricants are required for many of the mating surfaces. (iii.) Safety factors must be considered during installation.		a. determine the size, fit and clearance of engine components. b. employ a variety of testing devices to determine and isolate engine problems, and correct these problems.		
3.		a. investigate the visual and mechanical tests required to tune an engine to its specified performance. (i.) battery and cables (ii.) cranking motor and circuit (iii.) engine mechanical condition (iv.) spark plugs		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(v.) distributor and ignition circuit service (vi.) manifold and emission system service (vii.) carburetor and fuel system service (viii.) charging system (ix.) general vehicle inspection.		

Notes:

Topic III: ENGINE COOLING AND LUBRICATION

Generalization C: An internal combustion engine to function efficiently must operate within a limited temperature range and so must have means of dissipating heat produced by friction.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resource
1. The Internal Combustion Engine is Defined as a Heat Engine.		The student will: a. investigate the forces of friction in an engine, analyse their effects, and determine the methods of control. b. investigate the control of heat transfer and dissipation in the engine. i) pressure caps ii) thermostats iii) expansion tank c. identify the methods and types of seals and sealants used in the lubrication system.		

Notes:

Topic III: ENGINE COOLING AND LUBRICATION (Continued)

Generalization

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(ii.) Ford improved combustion system (iii.) air injector reactor system (iv.) thermactor system (v.) air guard system (vi.) Chrysler cleaner air package.		
(iii.) The fuel tank and the carburetor permit evaporation which accounts for 20% of the unburned hydrocarbons released from the automobile.		c. service fuel systems: (i.) thermal-expansion volume tanks (ii.) vapor-liquid separator (iii.) pressure-vacuum relief cap.		

otes:

VI. MECHANICS

3. Automotives 22B

Power Train

INTRODUCTION

Following the completion of the Automotives 22A module students may select any combination of modules from level two and three (22 and 32) except 32C.

I. OBJECTIVES

The objectives of Automotives 22B are:

1. to develop in the students the habits of critical thinking in the analysis of power train problems.
2. to acquaint the students with manufacturers' manuals and a variety of technical publications and to acquire faculty in their use.
3. to familiarize the student with automotive power trains and thus relate theoretical background to that of repair.
4. to provide the student with a basis for further study into power trains.
5. to develop in the student some of the attitudes and skills required of a motor mechanic.

II. CONTENT SUMMARY

1. Power train components and service
   - -clutch
   - -transmissions
   - -drive lines and universal joints
   - -rear axle assembly
   - -principles of differential gear adjustments
   - -disassembly, inspection and assembly of differential
   - -axles

III. REFERENCES

Auto Service and Repair. M. W. Stockel - and others as listed under Automotives 22A.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: MECHANICS

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH, TRANSMISSION, DRIVE LINE AND REAR AXLE

Major: Automotives

Generalization A: The function of the power train is to provide a flexible and variable means of transferring torque to propel the vehicle.

Course: Automotives 22B (Power Train)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Clutch				
(i.) The function of the clutch is to provide a flexible means of transferring torque from the engine to the transmission.		a. given any usual clutch component identify all parts and describe their function.	Learning situations may be conducted in the presence of live vehicles and/or selected training units. Parts identification and labelling projects may be completed on prepared diagrams using appropriate text books and/or shop manuals as reference. A selection of exhibits necessary to identify worn or damaged parts may be obtained from local garages. These exhibits can be numbered thus serving as projects to test behavioral objectives.	
(ii.) A unique path of power exists between the engine and transmission.		b. given a diagram of a clutch system, trace and record the path of power from engine to transmission.		
(iii.) Clutch engagement and release is accomplished through a series of levers, a		c. given a cross-sectional diagram of a clutch assembly, complete with linkages, accurately indicate the direction of lever action when the clutch is engaged or released.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH, TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
thrust bearing and external linkages.			Student projects must be selected on the basis of shop equipment available and complexity of model design.	
(iv.) An application of basic clutch construction and operation knowledge is essential for problem diagnosis.		d. given situations involving clutch parts wear, or failure, diagnose: (i.) clutch slippage (ii.) clutch chatter or grab (iii.) poor clutch release (iv.) clutch noise when pedal depressed (v.) clutch noise when pedal released (vi.) transmission shift problems due to clutch (vii.) other problems.		
(v.) An inspection of parts for acceptability or replacement is a very important facet of the repair procedures.		e. given parts of the clutch which are not acceptable, give reasons for their rejection and give probable causes of failure.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vi.) Pilot bearing.		f. locate the pilot bearing and describe its function. g. remove and replace the bearing/ bushing from the crankshaft.		
(vii.) Proper clutch service procedures must be accurately performed.		h. given a shop manual of a specific make and model of vehicle, write a brief summary of the procedures required to perform the following checks and record specifications (tolerances). (i.) alignment of clutch housing to crankshaft center line (bore run-out) (ii.) transmission attaching surface must be true (clutch housing run-out) (iii.) flywheel run-out. i. exhibit, on a training unit, his ability to disassemble a clutch assembly, identify parts, identify parts for replacement, re-assemble and adjust a clutch to provide satisfactory operation.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		j. given shop manuals of two or more different manufacturers, summarize the steps necessary to arrive at a generality of overhaul procedure.		
2. Transmissions				
a. Manual synchromesh transmissions are constructed with features common to all models regardless of manufacture.		a. given a 3 speed transmission, identify each part in the transmission and label the same on a prepared diagram. A detailed labelling of every part is necessary.		
(i) Speed, torque and directional change are functions of the transmission.		b. given gear combinations, calculate: (i.) Mechanical advantage (torque) (ii.) Speed Ratio. c. given gear combinations arrange these gears schematically to obtain a change in direction of rotation.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		d. given gear combinations with the number of gear teeth specified, arrange these gears to obtain changes in direction of rotation and calculate: (i.) torque (M.A.) (ii.) speed ratio.		
		e. given gears with the number of teeth specified, arrange the gears to obtain a torque multiplication and retain the direction of rotation of the initial gear.		
(ii) Gear ratios are selective and each selection has a unique path of power.		f. given a prepared diagram and a three speed fully synchronized transmission, trace the power flow through the transmission in: - low - second - high - reverse.		
(iii) Gear clash during a manual shift of gears is prevented by		g. given a modern synchromesh unit and connecting component parts, identify all parts and describe their operation.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
the action of a synchronizing unit which serves to bring two parts to the same speed thus permitting a mechanical connection.				
(iv) Movement of the synchronizing unit is initiated by a shift fork which is controlled by a detent and interlock system.		h. given a transmission detent system, identify the indents for all gears and describe their operation.		
(v) A transmission interlock system will prevent two gears from being engaged at the same time.		i. given a transmission interlock system, describe how an interlock system functions.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vi) Helical gears are strong and silent in operation but exert considerable thrust.		j. given a disassembled transmission, study the angle of teeth in each of the gears in mesh and determine the direction of thrust. From these observations, the student will explain the locations of all thrust washers within the transmission.		
(vii) Where there are two gears in mesh, each with respective countergears, a counter thrust takes place where one thrust balances the other.		k. upon observing the relative location and angle of the helical gears, explain the presence or absence of thrust washers.		
(viii) Transmission internal parts are lubricated by total immersion in lubricant or by splash.		l. given a clutch shaft, identify the oil passages of the clutch shaft and transmission housing that lubricate the: (i.) needle bearings (ii.) front bearing (iii.) rear bearing.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		m. given the mainshaft assembled, observe the oil passages and grooves of the idler gears and shaft.		
		n. given a transmission case, locate the oil filler plug and observe the relative position of the countershaft to the filler plug.		
(ix) When overhauling a transmission, a systematic procedure as outlined in the shop manual must be exactly performed.		o. given a three speed transmission and a corresponding shop manual, disassemble the transmission according to the procedures outlined in the shop manual.		
(x) The measurements as compared to shop manual specifications become the criteria of acceptability		p. given a disassembled transmission and corresponding manual, assemble according to the procedures outlined in the manual.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
or replacement of parts.		q. make all necessary checks and compare these to manufacturer's specifications. (i.) given a specific model of vehicle, read and summarize the procedures as outlined in the shop manual. (ii.) the above exercise will be repeated for installing the transmission plus an additional summary of linkage adjustments.		
(xi) Transmission removal is outlined in "shop manuals" of various automotive manufacturers.				
(xii) Diagnosis will require a thorough understanding of basic construction and operation to isolate the part or parts that are defective.		r. given one or more of the following hypothetical problems, itemize possible corrections (i.) hard shifting (ii.) gear clash during downshift (iii.) noisy in neutral - engine running (iv.) noisy only in one of the gears (v.) other problems.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
B. Automatic Transmissions				
(i) Construction		a. given an exploded view of an automatic transmission identify the components.		
(ii) Torque convertor		b. given a diagram of a torque convertor trace the flow of fluid in the convertor.		
(iii) Planetary gears		c. trace flow of power through gear set.		
(iv) Hydraulic Components -pumps -valves -servos -governors		d. given a diagram and actual samples of each unit, explain the operation of each unit and its location in the transmission.		
(v) Service		e. given a worksheet be able to perform a minor service job on a transmission.		

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
3. Drive Lines and Universal Joints (i.) A torque tube drive is an enclosed drive shaft which transmits power from the transmission to the differential and also transmits power from the axle housing to the frame. (ii.) A hotchkiss drive is an open propeller shaft that will transfer power from the transmission to the differential and the axle drive thrust is		a. given shop manuals of a vehicle equipped with lead spring and one other equipped with coil springs, determine how the driving force is transmitted from the axle housing to the frame.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
transmitted to the frame through the springs or control arms.				
(iii.) A universal joint will allow the propeller shaft to transmit torque through variations in drive angles and lengths.		b. given classroom models, identify the cross and roller universal joint and all the parts. c. By using appropriate texts as resource material, explain the speed fluctuating nature of the conventional universal joint and how this characteristic is adapted through design to develop a device that will automatically produce an even drive shaft speed. (constant velocity universal joints).		
(iv.) A slip joint is a device that allows the effective length of the drive shaft to change. This action		d. given a vehicle with a hotchkiss drive shaft, identify the slip joint and describe its operation.		

Notes:

52 Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
compensates for changes in drive shaft length resulting from movement of the rear axle housing.				
(v.) Universal joint service must be performed carefully to prevent damage to cups and seals.		e. given a vehicle with a faulty universal joint, remove and replace the universal joint by the procedure as outlined in the shop manual.		
(vi.) The propeller shaft must be accurately balanced with minimum run out and mounted at a specified angle.		f. given a vehicle equipped with a hotchkiss drive shaft, perform all measurements as outlined in the shop manual for propeller shaft service.		
4. Rear Axle Assembly				
(i.) The rear axle assembly is constructed		a. given a prepared diagram of a differential, label all parts using a shop manual as reference.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
to permit an effective transfer of torque while permitting the rear wheels to operate at different speeds.		b. given a differential model, identify all the parts.		
(ii.) The crown gear and pinion complex is the most predominant part of the differential.		c. using automotive texts as reference, identify a hypoid gear and discuss its advantages and disadvantages compared with the bevel and spiral bevel designs.		
(iii.) All pinion to crown gear ratios may be classified as: - hunting - non hunting - partial hunting		d. classify the differential model and describe the significance of the ratio.		
(iv.) Torque multiplication is dependent on the pinion to crown gear ratio.		e. given a differential assembly, count the number of teeth in the drive pinion and the number of teeth in the crown gear and		

Notes:

54 Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		calculate the mechanical advantage and gear ratio.		
(v.) Difference in speed or rotation of the two axles is accomplished within the differential case.		f. given a differential, hold one axle gear and observe the differential pinion gears rotate on the differential pinion pin and walk around the stationary axle gear.		
		g. observe, record and compare the number of revolutions made by the case to the number of revolutions of the axle gear that is in motion while one gear is held.		
(vi.) Torque will be equal to both wheels.		h. given a differential with axle stubs turn the differential case under two conditions: (i.) with equal resistance at both axles. (ii.) with resistance only at one wheel.		
		i. describe in writing the action within the differential case and note the stress between axle		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		gears and differential pinion gears.		
		j. record a part to part transfer of power from the drive pinion to the axles.		
(vii.) There are two basic ways in which pinion gears are supported.		k. given a straddle mount and overhanging mount pinions, compare the two designs for strength, accessibility and method of adjustment for pinion location.		
5. The Principles of Differential Gear Adjustment are Similar in Most Differentials				
(i.) Pinion bearings preload.		a. given a pinion with an adjustable crush sleeve, perform a bearing preload adjustment according to the procedures outlined in a shop manual.		
		b. using a text book as reference, identify one other method of adjusting the pinion bearing preload. (shims)		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Pinion position		c. using a shop manual and text as reference, discuss the relationship of the pinion mark to the carrier measure and the methods of adjustment.		
(iii.) Differential side bearing preload		d. given a differential assembly, practice a side bearing adjustment according to the procedures outlined in the shop manual.		
(iv.) Backlash		e. given a differential assembly, practice changing the backlash without disturbing the side bearing preload. This procedure will be clearly outlined in the shop manual.		
6. Disassembly, Inspection and Assembly				
(i.) A systematic approach to disassembly and inspection of parts of the differential is an important		a. given a differential assembly, disassemble and study each part in the sequence of powerflow, noting the points of possible wear.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

ncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
facet of service. Preliminary checks are a must prior to disassembly.		b. given a disassembled carrier, trace the oil flow to the bearings.		
(ii.) Assembly must be performed according to the shop manual.		c. assemble the differential and make all necessary checks and adjustments. Each check and adjustment will be recorded.		
(iii.) The success of the differential overhaul and adjustment is checked by a pattern.		d. given the differential assembly, "paint" the teeth and interpret the resulting pattern and make corrections where necessary.		
(iv.) Successful problem diagnosis results from applying the knowledge of basic construction and operation of the differential.		e. given the following problems, give possible causes and repairs. (i.) noise under load in straight ahead motion (ii.) noise when making a turn (iii.) a "clunk" when powerflow is interrupted (iv.) loss of lubricant (v.) overheating in the pinion bearing area.		

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Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
7. Axles (i.) Rear drive axle shafts are line axles and may be classified according to the amount of load exerted onto the axle. (ii.) Semi-floating rear axle is supported on the outer end by bearings. The axle will drive, retain and support the wheel. (iii.) Full-floating axle only drives the vehicle. The bearing in the housing will retain the wheel and		a. given diagram or models of semi-floating and full-floating rear axle assemblies, correctly identify all parts and describe their operation. b. be assigned to research several makes and models of cars to determine the method used to retain the axle in the housing. c. discuss the strengths and applicability of the two types of rear axles: (i.) semi-floating (ii.) full-floating.		

Notes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
support the load.				
(iv.) On a "non-slip" differential, torque may be evenly distributed to either wheel regardless of road conditions by controlling the movement of the axle (side) gears.		d. given shop manuals of several makes and models of vehicles equipped with a "traction differential", compare the differentials under the following criteria: (i.) location of differential clutches (ii.) type of clutches (cone or disc) (iii.) method of testing the efficiency of. e. by applying his/her comprehension of the standard differential, discuss the principle of operation of the "traction differential"		
(v.) The most important part of rear axle service is diagnosis.		f. research the various methods used for diagnosis by use of shop manuals. EXAMPLE: The student will outline a procedure for differentiating		

otes:

Topic I: POWER TRAIN COMPONENTS AND SERVICE. CLUTCH TRANSMISSION, DRIVE LINE AND REAR AXLE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vi.) Removal and replacement of axle seals and bearings.		wheel bearing noise to differential side bearing noise. g. given a rear axle assembly complete with housing, remove axles from the differential according to procedures outlined in the shop manual. h. study the bearing and seal complex but will not replace these as this assembly is a training model. i. where applicable, adjust axle end play and complete the axle installation as prescribed in the manual.		

Notes:

VI. MECHANICS

4. Automotives 22C

Alignment and Brakes

INTRODUCTION

The control of an automobile is dependent on the running gear and all its components. This module of study provides an introduction to the brakes, steering and suspension.

I. OBJECTIVES

This five-credit course is intended to provide the student with experiences that:

a. expose him, by direct involvement and reference book description, to those components of the automobile that are concerned with control characteristics such as steering, suspension and braking,

b. let him emply lifting, measuring and correction tools, and manufacturers' recommendations and specifications to assist in the diagnosis and elimination of problems,

c. make him constantly practice safety procedures while working with machines,

d. demand of him absolute cleanliness in the maintenance of the automobile parts, tools and facilities.

e. leave with him the sense of achievement and pride that will motivate self-improvement in the skills of diagnosis and correction of problems in automobile maintenance.

II. CONTENT SUMMARY

1. Wheel alignment
   -frame
   -front and suspension systems
   -distribtion of weight
   -axel fram relationships
   -tires
   -steering gear
   -shock absorbers

2. Steering geometry
   -adjustments
   -problems related to use and abuse

3. Brakes
   -common types
   -basic principles
   -emergency brakes
   -maintenance and repair

III. REFERENCES

* Stockel, *Auto Service and Repair*, Goodheart-Wilcox Co.

Crouse, *Chassis and Body*, 4th ed. 1971, McGraw-Hill Co.

Toboldt, *Motor's Automobile Repair Manual*, Goodheart-Wilcox Co.

Automobile Manufacturers' Shop Manuals.

Tools and Equipment Manufacturers' Manuals.

Nash and Bonity, *Automobile Technology*, 1973.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: MECHANICS

Topic I: WHEEL ALIGNMENT

Major: Automotives

Generalization: Stability and directional control are important factors in the handling of a vehicle.

Course: Automotives 22C (Alignment and Brakes

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. In Order to Maintain Stability and Control of the Vehicle it is Necessary to have a Number of Components Incorporated into the Vehicle				
(i.) Some type of structure is necessary for it provides the rigid foundation as well as a solid anchorage for the suspension systems.		a. given a variety of automobiles, identify: (i.) separate steel frames (ii.) integral body and frame.		
(ii.) Front and rear suspension systems are required to allow the body of the vehicle		b. examine and be able to identify front and rear suspension systems such as those equipped with "I" beam axles, coil spring, torsion bar-equipped independent front and rear suspensions,		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
to travel forward as well as to take turns with little roll or tendency to break frictional contact (skidding) between the vehicle and the road surface.		De Dion rear suspension systems. c. given a number of automobiles to examine, identify components in the suspension systems such as: (i.) springs, namely, leaf, coil, torsion bar (ii.) shock absorbers (iii.) sway eliminators (iv.) wheels and tires.		
(iii.) An ideal situation for stability and control is to have unsprung weight as small as possible in relation to the sprung weight on a car.		d. given an automobile, define both sprung weight and unsprung weight and name all the parts so affected.		

Notes:

Topic I: WHEEL ALIGNMENT (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(iv.) Various types of suspension systems maintain proper axle to frame relationship and also take the acceleration, drive and braking forces.		e. identify and describe methods of controlling rear end torque in vehicles equipped with: (i.) torque tube drive (ii.) hotchkiss drive.		
(v.) The wheel and tire assembly includes everything that revolves on the spindle or axle so any factor that has an influence on the rotating member also influences stability and control of the entire vehicle.		f. when given a typical wheel and tire assembly perform the following checks and corrections: (i.) inflation (ii.) run-out (iii.) balance (static and dynamic).		

Notes:

Topic I: WHEEL ALIGNMENT (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vi) Tire affect control and stability by their type and/or design.		g. examine tire types to draw diagrams to illustrate arrangement of materials in the tire and the type of materials in the tire, as well as the tread design.		
vii) The steering gear and related linkage convert rotary motion of the steering wheel to side to side motion of the front wheels permitting the operator to control the direction of the vehicle travel.		h. given appropriate diagrams label the various parts and relate the operation of these parts to control of the vehicle. i. given a manual steering gear be able to make the -worm bearing pre-load adjustment -pitman shaft end-play adjustment -high point or through center adjustment j. given a power steering gear be able to make the -linkage type power steering adjustment -integral type power steering adjustment k. given a vehicle be able to -adjust the ball and socket joint -replace tie-rod ends -align tie-rods -rebush or replace idle arm.		
iii) Shock absorbers assist in maintaining stability and control by		l. describe: (i) the action of shock absorbers (ii) the location		

Topic I: WHEEL ALIGNMENT (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
limiting the action of the wheels and/or body.		(iii.) the method of attachment to the vehicle.		
2. The Influence and Factors that Combine to Create Stability and Control are Brought About by the Angular Relationship Between the Front Wheels, the Linkage, and the Vehicle's Frame.				
(i.) Steering geometry is the term given to the interrelated angle of the axles, wheels, and other front end and rear end parts.		a. given a typical automobile and appropriate equipment exhibit competence in adjusting and/or measuring: (i.) caster (ii.) camber (iii.) toe-in (iv.) toe-out on turns (v.) steering axis inclination (vi.) included angle (vii.) curb height (viii.) tracking		

Notes:

Topic I: WHEEL ALIGNMENT (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(ix.) wheel run-out (x.) steering wheel centering.		
(ii.) The vehicle is constantly subjected to abuse therefore problems develop in the normal use of the vehicle.		b. identify, correct causes of, and write a report on: (i.) tire wear (ii.) hard steering (iii.) pulling to one side (iv.) vibration or wheel shimmy (v.) noise (vi.) wheel bounce (vii.) loose steering.		

Notes:

Topic II: BRAKES

Generalization The vehicle is driven by engine power, momentum, and/or gravity, but stability and control can be achieved completely only if a system known as brake system is incorporated.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Brake System in the Modern Automobile Consists of Two Basic Principles, Namely, (i.) Friction (ii.) Some Force to Provide That Friction and of Course, Materials Involved in Friction.		a. explain in a written paper friction, mechanical action and hydraulic action, and the parts involved in braking.		
2. Friction Materials are Generally the Same in All Vehicles.		a. list the materials used to provide the friction surfaces in the brake system in cars.		
3. Mechanical and Hydraulic Action Provide the Necessary Force to Create Friction to Slow Down or Stop the Vehicle.		a. describe the series of events that occur between the time that the operator applies pressure to the brake pedal and the vehicle stops.		
4. The Common Types of Brakes are the manually adjusted and self-adjusting, and the disc type.		a. disassemble, reassemble, and correctly adjust typical brake systems that he has been assigned to work on.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
5. Vacuum Assist Systems Emergency or Hand Brakes are Employed to Stop the Vehicle When the Service Brakes Fail or While the Car is Parking.		The student will: a. explain the application of vacuum to a diaphram, piston or bellows to increas the force at the push-rod. b. adjust linkage. c. check for vacuum leaks. d. check power assist operation with a gauge.		
6. Whenever Brakes are Used Certain Phenomena are Exhibited that Must be Taken into Consideration and Dealt with if the Units are to Function. (i.) Hydraulic fluid and the friction materials used in the system must possess characteristics such as withstanding tremendous temperatures and yet perform at low temperatures.		a. write a report discussing the brake fluid characteristics. b. describe materials such as asbestos and steel in terms of brake fade, for instance, and design of parts to dissipate heat.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) It has been found that the vehicle stops faster if the wheels are rotating than when they are locked.		c. examine and describe anti-skid devices and static and kinetic friction.		
6. Brakes Wear Out in Normal Use and Faster when Abused, Endangering the Lives and Property of the Operator and Others. The System Must be Restored to Safe Usable Condition.				
(i.) Diagnosis of condition is necessary if the operator, serviceman, or student is to know what and when certain components require		a. write a report after having examined conditions of possible failures, such as: (i.) no pedal (ii.) low pedal (iii.) hard pedal, wheels drag (iv.) vehicle is pulled to one side when brakes have been applies (vehicle moving)		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
rebuilding or merely adjustment.		(v.) noise.		

Notes:

VI. MECHANICS

5. Automotives 32A

Fuel and Tune-Up

INTRODUCTION

Automotives 32A may be selected at any time after the student has completed 22A. The module introduces the student to fuels, test equipment and the techniques used in tuning-up an engine.

I. OBJECTIVES

The objectives of Automotives 32A are:

1. to provide the students with a basis for further study into fuel and tune-up,
2. to demand of the students absolute cleanliness in the maintenance of automobile parts, tools and facilities.
3. to leave the students with a sense of achievement and pride that will motivate self-improvement in the skills of diagnosis and correction of problems in automobile maintenance.

II. CONTENT SUMMARY

1. Fuel system
   -types of fuel
   -fuel system components

2. Tune-up
   -test equipment
   -checking other systems of the automobile that relate to tune-up

3. Operational sequence for tune-up.

III. REFERENCES

Stockel, *Auto Mechanics Fundamentals.*

* Stockel, *Auto Service and Repair.*

Autolite Co., *Autolite Tune-Up Service Training Manual.*

* Wetzel, *Automotive Diagnosis and Tune-Up.*

Topic I: FUEL SYSTEM

Major: Automotives

Generalization: The fuel system along with ignition and mechanical components, is a prime factor of power in the internal combustion engine.

Course: Automotives 32A (Fuel and Tune-Up)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Fuel				
(i.) Gasoline		a. given the information explain the composition and characteristics of gasoline. Some of the topics included are: (i.) volatility (ii.) flame propogation (iii.) octane rating (iv.) detonation (v.) pre-ignition...etc.		
(ii.) Diesel fuel		b. given the information describe the composition and characteristics of: (i.) diesel fuel (ii.) liquified petroleum gas L.P.G.		
(iii.) Liquified petroleum gas (L.P.G.)				

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
2. Fuel System Components				
(i.) Fuel tank		a. given the information draw the construction and service of a fuel tank and its accessories.		
(ii.) Fuel lines and fuel filters		b. given the information describe the construction of fuel lines and fuel filters, used in the delivery of fuel, and in air pollution devices.		
(iii.) Fuel pump		c. given the information demonstrate the operation, service, and the testing of a basic fuel pump.		
(iv.) Fuel gauges		d. given the information explain the construction, operation, service and the testing of electric fuel gauges.		
(v.) Carburetors		e. given the information describe the purpose and construction of a basic carburetor. (i.) function and operation of the venturi		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(ii.) the purpose and the operation of each circuit found in common single and double barrel carburetors - float circuit - idle circuit - main circuit - accelerating circuit - power circuit - choke circuit.	The student should disassemble a single and a double barrel carburetor and be able to point out each circuit. Popular carburetors should be used if possible on a car or a live engine unit.	
		f. given a carburetor, make adjustments and diagnose systematically troubles common to each circuit in a carburetor.	A car or a live engine unit should be used for diagnosing carburetor troubles.	
		g. given the carburetor, clean a single and a double barrel carburetor kit, and then check its operation on a car or live engine unit.		
(vi.) Air cleaners		h. explain the operation and service of various types of air cleaners (i.) oil bath (ii.) paper		

Notes:

Topic I: FUEL SYSTEM (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(iii.) polyurethane (iv.) heated air intake.		
(vii.) Intake manifold		i. describe the operation and design of intake manifolds as used on various engine designs.		
(viii.) Exhaust manifold		j. analyze the operation and design of exhaust manifolds as used on various engine desings. e.g. 6 cyl. 8 cyl. V-8, 4 cyl opposed.		
		k. adjust the operation and service of a heat riser when used in an exhaust manifold.		
		l. describe the construction, purpose and service of exhaust mufflers, and resonators.		

Notes:

Topic II: TUNE-UP

Generalization A tune-up is an important factor for the efficient and maximum performance of an automobile.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Tune-Up		a. tune-up an engine for the purpose of: (i.) good performance (ii.) low fuel consumption (iii.) low air pollution.		
2. Test Equipment		a. use the following pieces of test equipment properly: (i.) dwell meter (ii.) volt meter (iii.) ammeter (iv.) ohmmeter (v.) compression tester (vi.) coil tester (vii.) spark plug cleaner & tester (viii.) engine scope unit (ix.) vacuum gauge (x.) timing light. NOTE: Other pieces of special test equipment can also be included if available.	Instruction books should be read thoroughly, and then tests be carried out on live shop engines or cars.	
3. Other Systems (i.) A tune-up				

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
requires an understanding of basic electrical circuits, fuel system components and good engine mechanical condition.				
(ii.) Electrical circuits are important to the proper operation of an engine.		a. trace the basic electric circuit in the car.		
(iii.) The fuel system is important to the proper operation of an engine.		b. draw the components and circuit of the fuel system.		
(iv.) Good engine mechanical condition is important for a good tune-up.		c. describe an engine in good mechanical condition.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(v) A knowledge of sources and methods used to reduce or eliminate pollution is important for a good tune-up.		d. adjust the devices used to control: (i) exhaust pollution (ii) crankcase pollution (iii) fuel tank pollution.		
4. Waste Control (i) Blow-by gases from the brankcase account for 20% of the unburned hydrocarbons released from the automobile		a. diagnosis crnak case emission systems (i) open PCV systems (ii) closed PCV systems (iii) PCV valve operation (iv) dual action valve (v) practical check of PCV systems (vi) testing PCV systems (vii) servicing PCV systems.		
(ii) Exhaust gases account for 60% of the unburned hydrocarbons released from the automobile.		b. diagnose exhaust emission systems: (i) controlled combustion system		
5. A Sequence of Operations is Important in a Tune-up.		a. follow a sequence of operations in performing a tune-up. One such sequence is: (i) test battery (ii) check spark plugs (iii) check compression (iv) check starting system (v) check fuel system (vi) check ignition system (vii) check charging system (viii) road test if possible. NOTE: Each part of the sequence can be enlarged on or the sequence can be modified slightly.	Tests should be performed on live engine units or a shop car.	

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(v.) A knowledge of sources and methods used to reduce or eliminate pollution is important for a good tune-up.		d. adjust the devices used to control: (i.) exhaust pollution (ii.) crankcase pollution (iii.) fuel tank pollution.		
4. A Sequence of Operations is Important in a Tune-Up.		a. follow a sequence of operations in performing a tune-up. One such sequence is: (i.) test battery (ii.) check spark plugs (iii.) check compression (iv.) check starting system (v.) check fuel systems (vi.) check ignition system (vii.) check charging system (viii.) road test if possible. NOTE: Each part of the sequence can be enlarged on or the sequence can be modified slightly.	Tests should be performed on live engine units or a shop car.	

Notes:

VI. MECHANICS

6. Automotives 32B

Electrical Systems

INTRODUCTION

The Automotives 32B module may be taken at any time following the completion of Automotives 22A.

I. OBJECTIVES

This five-credit course will provide the student with experiences that:

a. will relate previously mastered theories to modern mechanical developments,

b. will provide a basis for further research in the development of the automotive electrical systems,

c. can be related to other mechanics and electrical fields.

II. CONTENT SUMMARY

1. Electricity and magnetism
2. Sources of electrical energy
   -battery
   -generator
   -alternator
3. Application of electricity to the automobile
   -starting system
   -ignition system
   -lights
   accessories.

III. REFERENCES

Stockel, M. W., *Auto Mechanics,* (new ed.)

Stockel, M. W., *Auto Service and Repair,* Goodheart-Wilcox Co.

Toboldt and Johnson, *Motor Service's Automotive Encyclopedia,* Goodheart-Wilcox Co.

Venk and Billiett, *Automotive Fundamentals,* American Technical Society.

Billiett and Goings, *Automotive Electrical Systems,* McGraw-Hill Co.

Crouse, W., *Automotive Electrical Equipment,*

Delco Remy Training Series.

Topic I: ELECTRICITY & MAGNETISM

Major: Automotives

Generalization A: Electricity and magnetism are fundamental to the operation of the vehicle.

Course: Automotives 32B (Electrical Systems)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Modern Technology is Dependent on the Control of Electrical Power.		The student will: a. analyze and prepare a paper on the electrical nature of matter in terms of: (i.) the electron theory (ii.) static electricity (iii.) current and potential (iv.) electrical power (v.) sources of voltage (vi.) capacitance (farad) (vii.) electrical circuits.		
2. Magnetism is the Link Between Mechanical Power and Electrical Energy.		a. explain verbally, write a paper or set up experiments showing the laws governing the magnetic effects of the electrical cur rent in terms of: (i.) magnetic fields (ii.) permeability (iii.) shielding (iv.) magnetic induction (v.) solenoid action (vi.) transformer action (vii.) attraction replusion principle.		

Notes:

Topic II: SOURCES OF ELECTRICAL ENERGY

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Storage Battery is One Source of the Electrical Current Required by an Automobile and Becomes Part of Every Electrical Circuit.		a. identify the components of the storage battery and their relationship to each other, such as: (i.) number of cells (ii.) arrangement of cells (iii.) number of plates in cells (iv.) size of plates (v.) types of separators (vi.) electrolyte (vii.) container.		
2. The Basic Underlying Principle of Operation of the Storage Battery is that Electrical Energy is Produced by Chemical Reaction Between Two Metals Immersed in an Electrolyte.		a. correctly describe battery operation with the following aspects in mind. (i.) chemical reaction on discharge (ii.) chemical reaction during charge (iii.) effects of temperature (iv.) self-discharge (v.) rating.		
3. The Storage Battery is a Perishable Device and Will Serve its Useful Life Only if its Life is Pro-		a. when given a battery and appropriate test devices perform the following tests and corrective measures:		

Notes:

Topic II: SOURCES OF ELECTRICAL ENERGY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
longed with a Reasonable Amount of Care.		The student will: (i.) electrolyte level (ii.) specific gravity (iii.) open circuit voltage (iv.) high rate discharge (v.) 421 test.		
4. The Direct Current Generator and the Alternator are Sources of Electricity for the Automobile to Supplement the Storage Battery.		a. identify the components in the direct current generator and the alternator and describe the similarities and differences. He will compare and contrast in terms of: (i.) field (ii.) conductor (iii.) means of moving conductor through field (iv.) rectification (v.) control.		

Notes:

Topic II: SOURCES OF ELECTRICAL ENERGY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
5. The Direct Current System -battery -generator -regulator		diagnose the generating circuit troubles for: (i) battery condition, connections (ii) generator output test (iii) circuit resistance tests (iv) regulator setting tests.		
6. The Generator		a. clean the generator. b. test field coils for: -open circuit. -short circuit. -unintentional ground. c. machine commutator -undercut mica. d. armature test -open circuit. -short circuit. -unintentional ground. e. replace brushes. f. install drive and bearings. g. install commutator and bearing. h. perform motorizing test. i. install and test generator.		
7. The A.C. System -battery -alternator -regulator.		a. diagnose problems as with the D.C. system. b. disassemble, clean, test and repair an alternator.		

Topic III: APPLICATION OF ELECTRICITY TO THE AUTOMOBILE

Generalization B: The principles of electricity and magnetism are applied to the operation of various devices which make the automobile convenient and comfortable to operate.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Starting System		a. examine and be able to describe the components and operation of a typical starting system. This will include: (i.) starter motor (ii.) starter motor switch (iii.) starter drives (iv.) safety device i.e. neutral safety switch.		
(i.) Starting system problems		b. use test equipment to diagnose troubles and correct same if they exist. The tests will include: (i.) no load (ii.) stall torque (iii.) locked resistance (iv.) circuit resistance (v.) solenoid current draw (vi.) neutral switch.		
2. Ignition System		a. draw a diagram showing the primary circuit and the secondary circuit of the ignition system and label all the components in the system.		

Notes:

Topic III: APPLICATION OF ELECTRICITY TO THE AUTOMOBILE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(i.) The spark produced must be supplied to the engine at a very specific time in relation to engine condition and position.		b. describe the action that takes place in the engine under the following conditions: (i.) engine at stand still (ii.) engine idling (iii.) engine at high speed with no load (iv.) engine at low speed and heavy load (v.) engine at high speed and heavy load.		
(ii.) Ignition failures and normal lowering of ignition system efficiency are probably the most common automobile troubles.		c. diagnose ignition troubles and correct same: (i.) engine fails to start (ii.) engine is hard to start (iii.) engine misses while running.		
3. Lights		a. test and aim headlights, ensure operation of the directional signal, emergency warning, cornering, back-up, park and stop lights and others such as,		

Notes:

Topic III: APPLICATION OF ELECTRICITY TO THE AUTOMOBILE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		instrument, courtesy, dome, glove compartment, radio, panel, truck, hood, and any other light the vehicle may have as standard equipment.		
4. Accessories		a. identify these devices although he may not find time nor the need to make a thorough study of each of these devices. (i.) horn (ii.) windshield wiper (iii.) defroster (iv.) heater (v.) radio (vi.) power windows.		
5. Junction Blocks		a. inspect, disassemble and reassemble connectors. b. straighten prongs. c. ascertain that push type male-female connectors are tight and clean.		

Notes:

VI. MECHANICS

7. Automotives 32C

AUTOMOTIVES 32C

The last module of the Automotives sequence is open to students who have completed 30 credits or six modules in the major.

The 125 hours of instruction time available in this module may be used to:

(a) provide greater depth to a module taken previously. Individual students, groups of students or whole classes may elect to study an area in more detail to develop more skills. This in-depth study could be in power systems, tune-up, or any of the modules named in the Automotives sequence. OR

(b) engage in actual garage work through a program coordinated by the Automotives teacher and under a journeyman mechanic on the job.

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